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Working Paper: Summer Nudging: Can Personalized Text Messages and Peer Mentor Outreach Increase College Going Among Low-Income High School Graduates?

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Over the last several years researchers have devoted increased attention to how students' and parents' behavioral responses to complex information and complicated processes in education may contribute to persistent inequalities in access and achievement. Several recent low-cost interventions demonstrate that simplifying information about college and financial aid and helping students access professional assistance can generate substantial improvements in students' postsecondary outcomes. We build on this growing literature by investigating the impact of two applications of behavioral principles to mitigate summer "melt," the phenomenon that college-intending high school graduates fail to matriculate in college anywhere in the year following high school. One intervention utilized an automated and personalized text messaging campaign to remind students of required pre-matriculation tasks and to connect them to counselor-based support. Another employed near-aged peer mentors to provide summer outreach and support to college-intending students. The interventions substantially increased college enrollment among students who had less academic-year access to quality college counseling or information. Both strategies are cost-effective approaches to increase college entry among populations traditionally underrepresented in higher education, and more broadly, highlight the potential for low-cost behavioral nudges and interventions to achieve meaningful improvements in students' educational outcomes.

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SUMMER NUDGING: CAN PERSONALIZED TEXT MESSAGES AND PEER MENTOR OUTREACH INCREASE COLLEGE GOING AMONG LOW-INCOME HIGH SCHOOL GRADUATES?

By Benjamin Castleman & Lindsay Page

1. INTRODUCTION

Over the last decade, researchers and policy makers have increasingly leveraged principles from behavioral economics to advance public policy objectives. In fields ranging from environmental conservation and retirement planning to public health, public administration and financial education, policy interventions have employed low-cost behavioral nudges to achieve socially-desirable outcomes (Alcott et al, 2011; Beshears et al, 2012; Haynes et al, 2013; Karlan et al, 2010; Madrian & Shea, 2001; Stockwell et al, 2012). Until recently, applications of behavioral economics in the education policy arena were comparatively less frequent. Yet many of the challenges that behavioral interventions are designed to address—informational complexity, procrastination, status quo bias—are endemic in education. For instance, families evaluating school choices for their children often have to wade through dozens if not hundreds of school options. In New York City, public school students entering high school choose from among over 700 programs in more than 400 different high schools in the city (Walcott, 2013). Faced with so many choices, families may struggle to make an informed choice or not make an active choice at all, instead defaulting to keep their child in their assigned school even when higher-quality alternatives are available (Hastings & Weinstein, 2007).

Researchers are now devoting increased attention to how students' (and their parents') behavioral responses to complex information and complicated processes in formal schooling may contribute to persistent inequalities in educational access and achievement. Much of this research has focused on postsecondary enrollment and degree attainment, where the complexity of the college and financial aid application processes may deter academically-accomplished students from applying to or attending college at all, or from matriculating at institutions that are well-matched to their academic abilities (Avery & Kane, 2004; Bowen, Chingos, & McPherson, 2009; Dynarski & Scott-Clayton, 2006). Encouragingly, low-cost interventions that simplify college and financial aid information and provide students and families with assistance to complete college or financial aid applications can generate substantial increases in college entry and persistence (Bettinger et al, 2012; Carrell & Sacerdote, 2013; authors; Hoxby & Turner, 2013).

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We build on this growing literature by investigating the impact of two applications of behavioral principles to mitigate summer "melt," the phenomenon that college-intending high school graduates fail to matriculate anywhere in college in the year following high school (authors). Building on evidence that providing college-intending students with counselor-led outreach and support during the summer after high school improves the success with which they enroll and persist in college (authors), we assess the impact of two different innovations that apply behavioral principles to increase the efficacy and cost-effectiveness of summer support and outreach. The first intervention was a text messaging campaign through which college-intending recent high school graduates and their parents received ten text message reminders of key college-related tasks they needed to complete in order to successfully matriculate. The reminders were customized to inform recipients about the pre-matriculation tasks required by their intended college or university and were timed for delivery near the date when each task needed to be completed. Each message also provided recipients with the option of requesting follow-up counselor assistance by responding directly via text. The second intervention was a peer mentor intervention, through which college students reached out to college-intending high school graduates to support them in their college transition. The peer mentors provided information, encouragement and first-hand perspective on the college experience, helped assess students' readiness to matriculate in college, and connected students to professional support when needed.

We utilized a multi-site randomized controlled trial design, randomizing at the student level, to investigate the impact of these outreach strategies on students' postsecondary enrollment outcomes. To preview our results, the text message intervention substantially increased college enrollment among students with less access to college-planning supports and who were not as far along with their college planning at the completion of high school. For instance, students in Lawrence and Springfield, MA assigned to receive the texts were over seven percentage points more likely to enroll in college than their control group counterparts. By contrast, we find no impact of the text intervention in Boston, MA, where there is a high concentration of college planning supports during the school year and post-high school summer. The peer mentor intervention increased four-year college enrollment by 4.5 percentage points overall, with impacts similarly concentrated among those with less-defined college plans and less academic-year access to college-planning supports.

The text intervention was particularly cost-effective: the messaging campaign cost $7 per student, inclusive of the expense of hiring school counselors to support students who needed additional assistance. Given the low costs and sizable impacts we observe in several sites and among several student sub-groups, text messaging offers considerable promise as a strategy to deliver simplified information and to connect students to professional assistance—not only during the summer after high school but more generally at various stages in their educational trajectories when they and their families face complex information and complicated processes.

We organize the remainder of the paper as follows. In Section II, we review the behavioral economics literature relevant to interventions aimed at improving postsecondary access and success. In Section III, we describe our research design, including the sites, data and sample for each intervention; the design of each intervention; and the process of and timeline for randomization. In Section IV, we present our results. In Section V, we conclude with a discussion of these findings and their implications for policy, practice, and further research.

2. LITERATURE REVIEW

Despite pronounced returns to a college degree for students from low- and moderate-income backgrounds, disparities in college entry and completion by family income have persisted for decades and, if anything, have widened over time (Bailey & Dynarski, 2012; Long, 2008; Dale & Krueger, 2011). While differences in academic preparation contribute to these disparities, as many as half of students from lower socioeconomic backgrounds do not apply to academically-rigorous institutions to which, based on their credentials, they would have a good chance of being admitted (Smith, Pender, & Howell, 2012).[1] In addition, among those who do enroll and who would be eligible for Pell Grant support, upwards of 10 percent of students fail to complete the federal financial aid application, and as a result fail to obtain the financial assistance for which they would qualify. In short, many students—and particularly those from lower-income backgrounds—do not appear to be making optimal choices related to college entry and success.

2.1 Theories on why disparities in college entry and success by family income persist

[1] See also Manski and Wise (1983) which was likely the first analysis to observe the correlation between application choices and family income for students with similar academic qualifications).

Traditional economic models (e.g., Becker, 1964), assume that students are aware of both the benefits and the costs of higher education and posit that students will pursue a college education if the present discounted value (PDV) of the benefits of higher education exceeds the PDV of the costs of going to college. Empirical evidence, however, highlights the limitations of this traditional framework. For example, students from low-income families often provide estimates that substantially overstate actual tuition expenses (Avery & Kane, 2004; Horn, Chapman, & Chen, 2003; Grodsky & Jones, 2007) and are often unaware of aid programs specifically targeted at them (Avery & Turner, 2010).

Recent behavioral research suggests that people often over-weight immediate costs, both monetary and non-monetary, and forego investments that would be in their long-term interest (see, for example, Chabris, Laibson, & Schuldt, 2008). Faced with the time and cognitive burdens associated with college and financial aid applications, for example, students may delay addressing or abandon a key step in the admissions process — particularly if the alternative is something more enticing in the present moment (Madrian & Shea, 2001; Beshears et al, 2012; Scott-Clayton, 2011). Thus, even minor cost and process barriers may deter qualified students from successfully applying to and enrolling in college, despite a high probability that the lifetime benefits of higher education would far outweigh short-term investments.

For several reasons, socioeconomically disadvantaged students may be particularly prone to behavioral challenges related to attending college. First, the intricacy of the college application process itself may contribute to the persistence of gaps in college entry and success by socioeconomic status (Hoxby & Turner, 2013, Ross et al., 2013). Second, the complexity of the federal financial aid application may prevent students from obtaining the substantial federal, state, and institutional grant aid for which they are eligible (Bettinger et al, 2012; Dynarski & Scott-Clayton, 2006). The process of applying for financial aid is often even more difficult for the lowest-income students, compared to their middle income peers, because atypical income streams and household circumstances often trigger additional financial-aid related tasks, such as federally-mandated verification of the information students provide on their FAFSA (authors). Therefore, in the process of applying to college, the lowest income students are required to complete a broader array of complex tasks, furthering the probability of behavioral responses that lead them to put off or abandon entirely college and financial aid applications. Third, students from disadvantaged

backgrounds often have to devote their time and energy to addressing immediate stressors like supporting their families financially or dealing with neighborhood violence (Casey, Jones, & Somerville, 2011; Keating, 2004; Steinberg, 2008, 2009); the experience of dealing with scarcity on a daily basis may lead them to be particularly sensitive to incurring even seemingly small costs, such as those associated with college applications (Mullainathan & Shafir, 2013). Fourth, they are less likely to have access to college-educated family members or college counselors who can help them weigh short-term investments against long-term gains (authors; Schneider, 2009).

Even when students successfully navigate the process of applying for college admission and financial aid, a growing body of research has highlighted the many subsequent tasks to which students and families need to attend in the summer after high school graduation that can derail the college plans of strongly college-intending, recent high school graduates (authors). Until recently, the summer after high school has been overlooked as an important period in equalizing college access. Yet, there are a number of complex financial, procedural, and logistical tasks to which students need to attend during this period that can be particularly challenging for students from low-income backgrounds (authors). Despite these many requirements, the summer between high school and college is a uniquely nudge-free time in many students' educational trajectories and poses particular challenges for low-income students who no longer have access to high school counselors, who may not be familiar with support resources available at their intended college, and whose families may lack college experience. As a result, students who have already surmounted many obstacles to college enrollment and who would potentially earn high returns to postsecondary education may nonetheless fail to matriculate. Experimental research indicates that counselor-based outreach and support during these summer months increases the probability that students enroll and persist in college (authors).

2.2 Empirical foundation for the text message and peer mentor interventions

Our text messaging campaign builds on the foundational model of Karlan et al (2010), which posits that people fail to save because they are inattentive to (predictable) required future expenses. One prediction of this model is that regular reminders should mitigate this "attentional failure" and promote saving. Karlan et al (2010) test this prediction in three field experiments, finding that

individuals who received text reminders after opening a savings account were more likely to achieve savings goals and had higher overall savings.

In the context of the college-going process, the Karlan model suggests that attentional failure may induce students to mismanage their time and, in turn, miss deadlines and/or leave themselves with insufficient time to complete required tasks. Therefore, it is plausible that there is potential for "nudges" (Thaler & Sunstein, 2008), such as text messages, to help students maintain focus and manage their time throughout the college planning process. Since students from college-educated families are more likely to already get these nudges from other sources (e.g. parents, college consultants, etc.), students from lower-income, non-college educated families may be particularly likely to benefit from this text-based outreach.

Our peer mentor intervention builds on two recent interventions that provided peer mentor assistance during the senior year of high school. Bos et al (2012) found that near-peer advising from college students increased enrollment in four-year public colleges in California by more than 4 percentage points. Similarly, Carrell and Sacerdote (2012) matched Dartmouth College students with New Hampshire high school seniors who were behind in the application process. The college mentors met weekly with students during the second half of senior year to help them complete their college applications. Females in the treatment group were 12 percentage points more likely to enroll in college; this difference persisted into the second year of college.

2.3 Mechanisms by which text message outreach may impact students' outcomes

Text messaging is a promising approach to inform students of college-related tasks and to connect them to professional help when they need assistance. It is the predominant means by which young people communicate with each other. Whereas only six percent of teens exchange emails and 39 percent talk via mobile phones, 63 percent send texts on a daily basis (Lenhardt, 2012). Further, counselors who staffed the prior summer interventions cited texting as the most effective means of contacting students (Arnold et al, in progress). In addition, texting is a potentially cost-effective means to provide information and connect students to assistance. In the text message intervention discussed in this paper, for example, the marginal cost of each message was $0.01. Moreover, text-based outreach may increase counselors' efficiency. With a text platform, message delivery can be automated and content can be personalized to individual students and their postsecondary plans,

eliminating the need for counselors to invest substantial time conducting student outreach and ensuring that outreach can occur on a schedule that aligns well with when students are available (e.g. nights and weekends).

Personalized text messages could improve successful matriculation among college-intending students via several potential mechanisms. As we note above, it may be an efficient strategy for connecting students to counselors who can assist them to address summer obstacles that arise. Enabling students to request assistance via text mitigates several potential barriers to help-seeking. For instance, in schools where counselors have large caseloads and minimal time to focus on college planning, students may lack personal relationships with counselors (Civic Enterprises, 2012). Without a personal connection, students may be unlikely to initiate contact over the summer. In contrast, taking up the offer of help by responding to a text message may require considerably less interpersonal effort.

Personalized text messages may also inform students of required tasks about which they were unaware and/or may simplify the steps required to complete these tasks. With a modest investment of time to assemble the required tasks and deadlines for institutions most common among each partner district's graduates, we consolidated the set of required summer tasks into a series of ten institution-specific text message reminders. Most of the messages included institution- and task-specific web links that guide students directly to the web page relevant to a given task (e.g. registering for orientation). Finally, the text messages may impact students' college outcomes simply by nudging them to complete required tasks at the appropriate time during the summer. Personalized messaging effectively may turn adolescents' greatest liability during the college choice process—their impulsiveness—into an asset.[2] By providing simplified information and task-specific links, each message potentially allows completion of required steps in the moment, before students' attention is otherwise diverted.

2.4 Mechanisms by which peer-mentor outreach may impact students' outcomes

Peer mentoring also offers promise as a strategy to increase college going among low-income high school graduates. There are several channels through which peer mentoring could positively influence students' enrollment decisions. Students may be more responsive to outreach from peers

[2] We are grateful to Tom Kane for making this point.

than from adults. Peer mentors may be uniquely effective at shifting students' perceptions of social norms regarding postsecondary choices. Students from low-income or minority groups may lack a sense of belonging on college campuses if they perceive these institutions to be the domain of affluent, white students (Walton & Cohen, 2007). Their uncertainty about fitting in on campus may result in greater stress (Lovelace & Rosen, 1996), which can in turn impede completing required summer tasks. Faced with uncertainty about such tasks, students may be responsive to peer-led guidance if they believe that following the guidance and actions of others will yield better outcomes (Cialdini, 2001). Students may be particularly influenced by outreach from peers whom they perceive to be similar to themselves (e.g., of the same race/ethnicity, age, or gender) (White, Hogg & Terry, 2002).

Finally, interaction with a peer mentor may concretize the potential benefits of college. Time and travel costs may prevent students from visiting their intended college campus, and first-generation college students who received little college counseling may struggle to visualize college life. Thus, they may lack access to information about college that traditional human capital investment models would posit students possess. Students accordingly may be averse to foregoing current situations in favor of an unfamiliar environment (Kahneman & Tversky, 1979). Peer mentors may help to solidify students' perceptions of what college has to offer by sharing concrete details of their experience on campus.

2.5 Research Questions

We evaluate the impact of a text messaging campaign and a peer mentor outreach intervention on whether college-intending high school graduates successfully matriculate in college in the fall immediately after high school graduation. Our analyses are guided by the following research questions. First, does an automated and personalized summer text messaging campaign, which informs students of required college tasks and offers to connect them to professional college-going assistance, increase the probability that students enroll and attend college during the fall semester immediately after high school graduation? Second, do students who receive proactive outreach from a peer mentor during the summer enroll in college at a higher rate than those who do not receive any outreach? Third, do the text-message and peer-mentor based strategies impact rates of college enrollment similarly, or is one approach more effective? Finally, are these strategies

differentially effective based on the quality of college counseling and information students received prior to high school graduation?

3. RESEARCH DESIGN

3.1 Sites

During the summer of 2012, we conducted the text message and peer mentor interventions in collaboration with three educational agencies: the Dallas Independent School District (Dallas ISD); uAspire, a Boston-based non-profit organization focused on college affordability; and Mastery Charter Schools, a network of charter schools in the Philadelphia metropolitan area (Mastery).[3] We implemented the text intervention with Dallas and uAspire and the peer mentor intervention with uAspire and Mastery. Dallas ISD is a large, urban school district, serving approximately 158,000 students across 227 high schools. Approximately 7,000 seniors graduate from the district each year. uAspire operates several programs in partnership with the public school systems in Boston, Lawrence and Springfield, MA. The uAspire program most relevant to the interventions we examine is their High School Advising Program which places financial aid advisors in every public high school in each of the three districts. uAspire advisors spend at least one day per week working with students individually and in groups in each of their assigned school(s) for the entire school year. Mastery Charter Schools serve approximately 8,000 students in grades kindergarten through 12 across 15 schools, including five senior high school campuses.

The sites differ considerably in the extent to which students had access to college planning supports both during the school year and particularly in the summer. Boston, MA stands out for the high concentration of community-based organizations focused on college access and success. Several of these organizations, such as Bottom Line, provide wrap-around services to students through the summer months and into college. There is also a city-wide initiative, Success Boston, developed by the Mayor's Office and the Private Industry Council, to provide comprehensive support, including during the summer after high school, as students transition to college. Dallas and Philadelphia also have several college access organizations that provide support to students during the academic year, however these organizations have not historically extended their support into the summer after high school. Lawrence and Springfield, MA stand out for the relative paucity in college

[3] More information on our partnering sites is available online. Dallas ISD: www.dallasisd.org. uAspire: www.uaspire.org. Mastery Charter Schools: www.masterycharter.org.

access organizations. Both cities have federal college access programs like TRIO and Upward Bound, which tend to focus their efforts earlier in the college exploration and application processes and do not typically work with students after high school graduation. Otherwise, uAspire is the only community-based organization providing college planning support to students in these communities.

These community-level differences in access to college planning supports have important implications for the potential impact of the summer interventions. For instance, students in Lawrence and Springfield may have been particularly responsive to the offer of personalized information or personal outreach from a near-age peer, given that they received less support with the college and financial aid processes while in high school. By contrast, the additional information the text messages provided may have been less impactful in Boston because students already had so much access to college information and assistance during high school and continuing into the summer after high school graduation.

3.2 Data and Sample

Our investigation capitalizes on several data sources. First, each site provided student-level demographic and prior academic achievement information. These data include students' gender, race/ethnicity, free/reduced price lunch status, FAFSA completion status, high school GPA, and scaled score on state achievement tests. The data do not align perfectly across sites. While we have a common set of demographic information across all sites, we have senior year GPA and math and English language arts state assessment scores in Dallas and Philadelphia, but only a self-reported categorical measure of students' high school GPA for the uAspire sites. We have records of students' college intentions for the uAspire and Mastery sites, but we do not have this information for Dallas ISD.[4] Second, the sites also maintained and provided interaction-level records from peer mentor and counselor interaction logs. These logs include information on whether students took up the offer of help; when and where the interaction took place, and what help the mentor or counselor provided. Third, each site obtained student-level college enrollment outcomes from the National Student Clearinghouse, a non-profit organization that maintains postsecondary enrollment records at

[4] Students did report their specific college intentions on the Dallas ISD exit survey. The survey was done on paper, however, and Dallas ISD was only willing to have counselors record this information in a spreadsheet for students assigned to the text message intervention. Counselors then transferred this information directly to the text message provider.

approximately 95 percent of colleges and universities in the country.[5] Finally, among students assigned to text messaging, Signal Vine, the text messaging platform we contracted to deliver the text messages, provided data on whether recipients responded, the date of their text response, whether they requested help, and whether they requested that they stop receiving messages.

The experimental sample includes Class of 2013 high school graduates whom we identified as college-intending. Our definition of college-intending varied across sites. By virtue of participating in the US Department of Education FAFSA Completion Pilot, Dallas ISD had student-level records on students' FAFSA completion status.[6] We identified students as college-intending if they had completed (or at least started) the FAFSA as of high school graduation. 2,920 of 8,066 seniors in Dallas ISD met this criterion. In the uAspire sites, we identified students to be college intending if they had initiated at least two individual meetings with a uAspire advisor during their senior year of high school. uAspire leadership identified this benchmark as a relevant demarcation between students with moderate to strong college intentions and students whose postsecondary plans were more uncertain. 2,833 of 4,042 students who received individualized assistance from a uAspire advisor during senior year met this benchmark. For Mastery, we capitalized on high school exit survey data to identify college-intending students. Of 568 graduating seniors, 443 reported specific postsecondary plans and were therefore included in the Mastery sample.

In Tables 1 and 2, we provide descriptive statistics by intervention site, for both the overall sample and the analytic sample of college-intending students. In Table 1, we present demographic characteristics, and in Table 2, academic achievement and postsecondary intention information. Across sites, the sample includes primarily students of color and students who qualified for free or reduced price lunch (FRL). In Dallas, by the end of senior year, just over one third of seniors (36 percent) had completed the FAFSA. The subset of Dallas ISD seniors who completed the FAFSA were more likely to be female, more likely to be black, and had state standardized test scores that were approximately 0.30 standard deviations higher than for the senior class as a whole. Across the uAspire sites, 65 to 75 percent of all students who met with an advisor at least once during senior

[5] An important point about the NSC data is that coverage rates vary considerably by state. For instance, in West Virginia the NSC only covers 68 percent of higher education institutions. Fortunately, the coverage rates are fairly high in Massachusetts (94 percent), Pennsylvania (90 percent), and Texas (90 percent), where the majority of students in our experimental sample attend college (Dynarski, Hemelt, & Hyman, 2012).

[6] The FAFSA is the Free Application for Federal Student Aid. For more information on the FAFSA Completion pilot: http://studentaid.ed.gov/data-center

year completed the FAFSA by the end of high school, with substantially higher FAFSA completion rates among those who met with an advisor at least twice. Students' college intentions differ notably across the uAspire sites. Only one-quarter of Boston students intended to enroll at a two-year institution, compared to 64 percent of Lawrence students and 58 percent of Springfield students. Within sites, college intention patterns were similar between the overall sample and those students who met with an advisor at least twice during the year. In the Mastery high schools, 95 percent of students with college intentions had completed the FAFSA. Mastery seniors graduated with an average GPA of 2.56. GPA was somewhat higher and standardized test performance marginally higher among Mastery's college-intending graduates.

3.3 Intervention design

In this section, we describe the text message and peer mentor intervention designs (See Appendix A for additional details).

Intervention 1: Text Messaging to Provide Information and Offer Support

The core of the text messaging campaign was a series of ten automated text messages to remind students and (where possible) their parents of tasks required by their intended college and to prompt recipients to request help with these tasks, if needed (see Appendix Figure A1 for templates for all text messages). When students or parents responded to a text message, this connected them to an assigned counselor to provide additional, one-on-one assistance.[7] More specifically, the messages reminded students to: log on to their intended college's web portal (e.g., wolverineaccess.umich.edu) to access important paperwork; register for orientation and placement tests; complete housing forms; and sign up for or waive health insurance, if relevant. The messages also offered students help completing the FAFSA, if they had not done so already, and interpreting their financial aid award letter and tuition bill from their intended college. Most messages included web links that allowed students with smart phones and data plans to complete tasks directly from their phone.[8] The text messages were delivered between early July and mid-August in approximately five-day intervals.[9] We contracted with Signal Vine, a start-up company aimed at improving

[7] Students planning to attend a less common institution received a generic set of reminders.
[8] The actual message content is available upon request.
[9] In Appendix Figure A2, we provide a comprehensive timeline for both interventions.

education outcomes through the application of mobile technologies, to deliver the messages. For additional details on the information we relied on for the text messaging campaign, see Appendix A.

Intervention 2: Personal outreach from peer mentors currently enrolled in college

The peer mentor intervention was modeled on the summer counseling interventions described above, in which counselors proactively reached out to offer students college transition support. The primary difference was that college students who had graduated from high schools in each uAspire site or from a Mastery high school were conducting the outreach and providing the first level of support and guidance. uAspire and Mastery were responsible for peer mentor selection.[10] They were also responsible for training, ongoing support and supervision of the mentors throughout the summer.[11] The sites employed twenty peer mentors (in total) from mid-June through mid-August, and each mentor worked approximately 20 hours per week. Nine were based in Boston, two in Lawrence, three in Springfield and six in Philadelphia.

Peer mentors' first-order task was to make contact with students and assess their readiness for fall college matriculation. Core topics that peer mentors covered in their initial conversations included whether students: (1) were still planning to enroll in college; (2) were planning to follow through on their previously articulated plan; (3) had completed the FAFSA; (4) had received and reviewed a financial aid award letter; and (5) had registered for orientation and placement tests. Following this initial assessment, peer mentors scheduled in-person meetings or follow-up phone conversations to help students address issues that arose. However, peer mentors did not work on tasks, such as completing the FAFSA, which required students to provide financial information about themselves or their families. For these tasks, and any others in which the peer mentors felt the need for additional guidance to comprehensively support the student, peer mentors referred students to meet with a supervising counselor. See Appendix A for information on the advisor staffing structure for the peer mentor intervention.

[10] They selected peer mentors based on several primary criteria: students had to have worked with uAspire during high school or have graduated from a Mastery high school; be enrolled in college and in good academic standing; and have received financial aid and have a clear understanding of the financial aid process.
[11] For additional information on the training content, see Appendix A.

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3.4 Randomization and caseload assignments

Dallas ISD implemented the text messaging intervention only. In Dallas ISD, the head of counseling first assigned each of the nine participating counselors to a set of high schools within the district. Within each high school, the district then identified students who had completed the FAFSA. Among FAFSA completers and within each counselor's cluster of high schools, students were randomly assigned either to the text outreach condition or to the control (no outreach) condition. The district randomized students in early June, with the first text messages delivered to students in early July. Across school clusters, 1,454 students were assigned to treatment and 1,466 to control.

uAspire randomized students separately by site and assigned students to one of three experimental groups. Of the 1,843 students in Boston in the experimental sample, 697 were assigned to the text intervention, 450 to the peer mentor intervention, and 696 to the control group. Of the 294 eligible students in Lawrence, 100 were assigned to the text intervention, 94 to the peer mentor intervention, and 100 to the control group. Finally, of the 696 eligible students in Springfield, 273 were assigned to the text intervention, 150 to the peer mentor intervention, and 273 to the control group.

Mastery implemented the peer mentor intervention only. Mastery randomized students separately within each of the five participating high school campuses. Each campus randomly selected a caseload of 40 students for each participating peer advisor. In the largest campus staffed by two peer mentors, 80 students were selected and distributed at random to these mentors. At each campus, the remaining eligible students were assigned to the control group. In total, 240 students were assigned to receive peer mentor outreach and 203 students to the control group. For both uAspire and Mastery, randomization was conducted in mid-June, with peer mentor outreach beginning in late June and the first text messages delivered to uAspire students in early July.

In Table 3, we assess the baseline equivalence of the treatment and control groups within each site. With a comprehensive set of baseline covariates, testing baseline equivalence for each covariate individually can lead to the detection of significant differences due to an increase in the probability of Type I error (Hansen & Bowers, 2008). We therefore utilize the omnibus measure of baseline balance developed and described by Hansen and Bowers (2008). In this approach, we focus on the

associated Wald (χ^2) statistic for assessing baseline equivalence. Across sites, we fail to reject the null hypothesis of baseline equivalence based on the omnibus results. There are scattered instances in which we detect modest imbalance on individual covariates, but this is to be expected, given the number of tests we conduct. Furthermore, where detected, the direction of the imbalance would plausibly lead to downwardly-biased estimates of the treatment impact. Overall, we have achieved baseline equivalence in the site-specific samples, and while not shown, baseline equivalence is satisfied in the pooled data as well.

3.5 Measures

To evaluate the impact of the interventions on students' initial college enrollment in the fall semester following high school graduation, we focus on three primary outcome measures. These include binary indicators for enrollment in any college in the fall semester following graduation; enrollment in a two-year institution; and enrollment in a four-year institution. The explanatory variables of primary interest are indicators for the experimental group to which each student was assigned. To increase precision, we include the academic, demographic and, where available, college intention covariates described in Tables 1 and 2. We include indicator variables for missingness for any covariate with missing values. We also include fixed effects for the level at which randomization was conducted at each site: counselor fixed effects for Dallas, site fixed effects for uAspire, and high school campus fixed effects for Mastery.

3.6 Empirical Strategy

To investigate the impact of each treatment on the binary college outcomes, we utilize probit models.[12] We present results of the interventions both for the pooled sample and separately by site. Within the uAspire-specific analyses, we report the results of both the text message and peer interventions on students' outcomes. We specify the following Intent-to-Treat (ITT) model for our analyses:

[12] We recognize the potential for bias in statistical estimates that derive from probit models with fixed effects due to the incidental parameter problem. Simulation results by Greene (2004) suggest that with the number of group-level fixed effects included in our model, together with the number of observations per group (ranging from 65 to 1843), our results should not suffer from such bias. In addition, we ran all analyses using linear probability models (LPMs) with the same set of fixed effects and covariates as an additional check. In some instances, coefficients were somewhat larger and in other cases somewhat smaller, but both the substantive conclusions and the patterns of statistical significance remained unchanged. These LPM results are available upon request.

$$(1)\ \Pr(COLLEGE_{ij} = 1) = \Phi(\alpha_j + \beta_1 TEXT_{i} + \beta_2 PEER_{ij} + \boldsymbol{X\gamma} + \varepsilon_{ij}),$$

where for student *i* assigned to counselor or site *j*, $COLLEGE_{ij}$ represents a college enrollment outcome; α_j is a fixed effect for the site-appropriate level within which randomization was conducted; and $\boldsymbol{X}$ is a vector of student-level covariates. In this model, β_1 provides the causal effect of the text messaging intervention on students' outcomes, and β_2 provides the causal effect of the peer mentor intervention on students' outcomes. For ease of interpretation, in our results, we present marginal effects of assignment to treatment holding all covariates at the average. This marginal effect corresponds to the predicted change in probability of the outcome of interest (such as fall college matriculation) for the average student assigned to the relevant intervention, compared to the average student assigned to the control condition. In the uAspire sites, a chi-squared test on the hypothesis that β_1 is equal to β_2 indicates whether there was a differential impact of the peer mentor or text interventions.

We also examine whether there were heterogeneous effects of either treatment. We focus in particular on whether the treatments had larger effects on students with less access to college and financial aid information, and on students with less defined college plans as of high school graduation. Our rationale is that these sub-groups would be most impacted by personalized reminders of important college tasks to complete and by the offer of individualized assistance from a peer mentor or school counselor. We proxy for access to college information in several ways. First, we examine whether the intervention had differential impacts by site, given the disparities in access to college planning supports discussed earlier. We also investigate whether the impact of the treatment varied by students' senior year GPA. Specifically, we reason that students with GPAs in the middle of the academic distribution may have benefited most, as these students may have been college-ready but less likely to benefit from individualized college assistance during high school. We examine whether the impact of the interventions varied by whether students had a specific college they planned to attend as of high school graduation, on the theory that students who were still undecided about which college to attend were less likely to have received information about required tasks to complete over the summer.[13] Finally, we examine variation in treatment impacts by FAFSA

[13] In Lawrence and Springfield, advisors were able to contact almost all students, or in Springfield rely on district data on students' college intentions as of high school graduation, so the college intentions information in these sites is quite complete. In Boston, there was a greater number of students who uAspire advisors were not able to contact

completion status, given that FAFSA completion is a key college-going step, particularly given the socioeconomic background of the majority of the students in this study.

We additionally conducted several descriptive analyses to explore channels through which each intervention may have impacted students' outcomes. To assess whether the text intervention increased recipients' knowledge about key summer tasks, we used implementation data corresponding to each message to document the number of recipients that followed the embedded institution-specific web links. We capitalized on the fact that uAspire students were randomly assigned to either receive text messages or peer mentor outreach to investigate whether there were differences in the proportion of students in each group that met with a uAspire advisor over the course of the summer. In the case of the peer mentor intervention, we also examined the proportion of students' interactions that were with peer mentors vs. uAspire advisors.

4. RESULTS

4.1 Intervention implementation

We first examine the campaign's success in actual text message delivery and the extent of student responsiveness to the text and peer mentor outreach strategies. One challenge in implementing a text messaging intervention is simply getting the phone numbers to which messages can be sent. In Table 4, we present descriptive data on the text delivery rates, as provided by Signal Vine. In Dallas, of the 1,454 students assigned to the text intervention, only 843 provided a phone number on the high school exit survey. Of these 843, Reify verified that the considerable majority, 814, had working cell phone numbers.[14] Thus, between students who did not provide a cell number and a small share with invalid numbers, we were only able to send messages to 56 percent of Dallas ISD students assigned to the text intervention. The uAspire rates are somewhat higher: out of 1,070 students assigned to receive texts, 806 provided a phone number, and of these, 768 were working cell phone numbers. Thus, we were able to message 72 percent of those uAspire students assigned to receive texts.

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at the end of senior year, so for these students, it is harder to disentangle whether the students' were undecided about their college intentions, or if they had just not communicated their plans to uAspire.

[14] Signal Vine was not able to verify that the number belonged to the specific student to whom it was linked in the data, nor that the messages were necessarily delivered to or opened on the phone linked to that number.

In the lower panel of Table 4, we present analogous figures for the parental cell phone numbers. Over half (811) of Dallas ISD students provided a parent cell phone number; of these, Reify was able to send messages to 663 working numbers. uAspire provided parents' phone numbers for over 70 percent of students, though uAspire was not able to distinguish whether these were land line or cell phone numbers. As a result, only 232 of the uAspire parent numbers were working cell numbers. Across sites, there were some students for whom we had a parent number but not a student number. In sum, we were able to message either a student or a parent for 60 percent of students in the Dallas sample and 85 percent of students across the uAspire sites.

In Tables 5, we explore several measures of intervention take-up for both the text and peer mentor interventions. For the text intervention, we report the proportion of treatment group students who replied to at least one message and who requested a meeting with a counselor in response to a message, by site (top panel). In the bottom panel, we report the proportion of students who interacted with an advisor or peer mentor in both the text and peer mentor interventions. We define each of these measures at the student level, meaning that a student is coded as having replied if either she or her parent responded to a message.

Text message response rates varied across sites. Approximately 31 percent of students assigned to the text messaging intervention in Dallas responded to at least one message, compared with 34 percent in Springfield, 37 percent in Boston, and 48 percent in Lawrence.[15] The proportion of students requesting help in response to a text message was considerably lower. Eleven percent of students in Dallas requested help, while fewer than six percent of students assigned to the treatment group actually interacted with a school counselor.[16]

In the uAspire sites, by contrast, the proportion of students who worked with a counselor was closer to the share of students who requested help via text message. In Boston, 19 percent of students requested help from a school counselor, while nearly 17 percent of students actually interacted with a counselor. In Lawrence, 31 percent of students requested help from a school

[15] These response rates pertain to all students assigned to the intervention, not just those to whom Reify sent messages. Response rates for this subset would be higher. This is particularly true in Dallas where Reify only received student numbers for 56 percent of the treatment group.

[16] Based on the counselor interaction logs, the gap between the proportion of students in Dallas who requested help via text message and the proportion who actually received assistance appears to be primarily a function of counselors not contacting students until several days passed from the students' original request. At that stage, the student was often not responsive to counselor outreach. The delay in their response to students' requests for help appears to be mainly a function of the counselors having large caseloads (inclusive of a separate intervention focused on FAFSA completion) and limited hours in the summer to devote to both interventions.

counselor, while 29 percent of students interacted with a counselor. The analogous figures in Springfield are 16 and 15 percent. The considerably higher alignment between meeting requests and actual meetings may be attributable to faster turnaround time of text responses as well as to the strong relationship that many uAspire students have with the organization overall and, in many cases, with a specific advisor.

By construction, students in the peer mentor group did not reply to any text messages or request a meeting with an advisor via text message. But their rates of interaction with an advisor or peer mentor were substantially higher than for students in the text message treatment group. Across sites, between 50 and 60 percent of students assigned to receive peer mentor outreach interacted with either a mentor or advisor during the summer, with the majority of these interactions being with a peer mentor (Appendix Table A2).

A potentially important aspect of the text message intervention was the institution- and task-specific web links included in the personalized messages, since these links may have facilitated students completing required tasks in the moment, directly from their phones. Across tasks and sites, click-through rates were modest relative to the total number of students and parents to whom Signal Vine was able to send messages (Appendix Table A3). We are unable to directly observe the extent to which message recipients acted on the information provided in the text messages in ways other than if they clicked through on web links and/or responded to connect with a counselors.

4.2 Intervention impact

We begin in Table 6 with the impact of the text message intervention by site as well as pooled across sites. In each set of results, the first column presents impacts on overall enrollment, the second column presents impacts on enrollment in four-year institutions, and the third column presents impacts on enrollment in two-year institutions. All models include fixed effects for the level of randomization and the full vector of control covariates.[17] While not shown, across outcomes, the treatment coefficients are stable to the inclusion of a full set of covariates.

[17] We estimate treatment effects for the text and peer mentor interventions with separate models including only those sites where the focal intervention of interest was implemented. In order to improve the precision of our results, however, in all analyses we maintain students across all three groups. For example, the models estimating impacts of the text intervention also include a dummy variable for assignment to the peer mentor intervention, but this model is estimated only within those sites that included a text intervention.

The variation in the site specific results supports the notion that the text-based outreach would be more impactful in districts where students had less access to college planning supports. In Dallas, we find a pronounced impact of the text intervention on whether students enrolled at two-year institutions. Students in the treatment group were almost five percentage points more likely to enroll at two-year institutions than students in the control group. Though not displayed in the table, enrollment increases were most pronounced for students who qualified for free- or reduced-price lunch (FRL), which comprised approximately 80 percent of the Dallas sample. FRL students who received the text messages were over four percentage points more likely to enroll overall than their counterparts in the control group.[18] Adjusting for having a working cell phone number for either student or parent, this two-year enrollment impact is nearly 8 percentage points. Across enrollment outcomes in Boston, none of the coefficients on the text treatment indicator is significant. In the pooled Lawrence and Springfield results,[19] the text intervention had a particularly pronounced impact: students in the text treatment group were 7.1 percentage points more likely to enroll in college (column 7), with this impact roughly equally divided between increases in four-year and in two-year enrollment. Because uAspire was able to obtain working cell phone numbers for nearly all students or their parents in Lawrence and Springfield, the instrumental variables estimate of the impact of receiving text messages is essentially the same. Aggregating across the sites, yields a positive impact of the text intervention on enrollment at two-year institutions. Because the Lawrence and Springfield sample size is small compared with the Dallas and Boston samples, the large impact in those sites is diminished in the pooled results.

In Table 7, we present an analogous set of results associated with the peer mentor interventions. Here, we observe that the coefficients on the peer mentor intervention in the uAspire sites are positive, particularly for four-year enrollment, though again not surpassing the margin of significance. The peer mentor impacts in Philadelphia are small and not significant. Pooling across the sites, those assigned to receive peer mentor outreach were 4.5 percentage points more likely to enroll in a four-year institution. While not shown, additional analyses to test whether the impacts of

[18] These results are available upon request.

[19] In this table, and all subsequent sets of results, we report results pooled across the Lawrence and Springfield sites. We do so for two primary reasons: first, as we demonstrated descriptively, these communities are very similar to each other on a host of characteristics related to college attainment. Second, from a technical standpoint, the magnitude of the enrollment impacts is quite similar across the two sites, and pooling them increases our statistical power to detect impacts across the two sites (see Appendix Table A4 for details).

the text and peer mentor interventions were equivalent, in general, revealed that the two strategies did not yield significantly different impacts on college enrollment outcomes.

In Table 8, we examine heterogeneity in impacts across student characteristics, both within each of the sites and for the cross-site, pooled sample. The results provide consistent evidence that the text and peer mentor interventions were most beneficial for students with little access to college planning supports and/or less-developed college plans. We examine the impact of the intervention by level of high school GPA (rows 1 through 3); and for the uAspire sites, whether or not students had articulated specific postsecondary plans (rows 4 and 5). Finally, we present impacts by FAFSA completion status (rows 6 and 7). These results pertain only to uAspire as well. There was no variation in FAFSA completion status in Dallas, by design, and virtually all of the Mastery students had completed the FAFSA. Of students in the uAspire sites, 382 students had not completed their FAFSA.[20] Given the relatively small number of FAFSA non-completers within each of the three uAspire sites, we opt to present only the pooled results by FAFSA completion status but note that the site level results were largely consistent with the pooled estimate.

To examine variation in impacts by academic achievement, we create a categorical GPA variable to reflect a relatively low, moderate or high level of GPA among the students in the sample.[21] We anticipate students with moderate GPAs to benefit the most from additional information and assistance through the summer. These students are likely to be academically college-ready but may have been less likely to have received adequate college counseling during high school, as such supports, where present, may have been more likely to be directed towards the highest-performing students. We observe a consistent pattern of positive and significant impacts among students with GPAs in the middle of the distribution, but only modest and non-significant effects for students at either the low or high end of the distribution. For example, across sites, both the text and peer mentor interventions significantly improved timely matriculation by 4 and nearly 6

[20] More accurately, this is an indicator of not having completed the FAFSA together with a uAspire advisor. In this way, the FAFSA indicator can be considered a proxy for the extent of uAspire advisor support that the student utilized during the academic year.

[21] The distributions of GPA—and accordingly our definition of low, moderate, and high GPAs—differed markedly across the sites. For Mastery and Dallas ISD, a low GPA is defined as less than 3.0; a moderate GPA between 3.0 and 3.5; and a high GPA above 3.5. For the uAspire sites, a low GPA is defined as below 2.0; a moderate GPA between 2.0 and 3.0; and a high GPA above 3.0. Because college counseling is a finite resource within schools, students' access to counseling is typically determined by where they fall relative to their peers. Thus, we are interested in site-specific measures of students' performance within the overall GPA distribution.

percentage points, respectively, for students with mid-level GPAs. In contrast, impacts are negative but not significant for students with low or high GPAs. These patterns are notably consistent for results disaggregated by site.

Across the uAspire sites, we find pronounced impacts of both interventions for students who did not have specific college plans as of high school. The text outreach increased on-time enrollment among these students by nearly 6 percentage points across the sites, while the peer mentor intervention increased overall enrollment by nearly 9 percentage points among students without specific plans at the end of high school.

Finally, we capitalize on variation in FAFSA completion within the uAspire sites to investigate whether the interventions were more impactful for students who had not completed the FAFSA with uAspire prior to high school graduation. We find no impact of the text or peer mentor interventions for students who had completed the FAFSA, but we do observe pronounced impacts for students who had not completed a FAFSA with uAspire prior to graduation. Text-based outreach increased timely enrollment for non-FAFSA completers by a statistically significant margin of 20 percentage points. We interpret the large magnitude of this estimate with caution, given the relatively small number of students who did not complete the FAFSA across the uAspire sites. The impact of the peer mentor intervention was sizeable in magnitude but very imprecisely estimated.[22] As noted, lack of FAFSA completion could indicate that students were not as far along in their college planning and/or that students were less engaged with uAspire during the school year. In either case, additional information and outreach over the summer appeared beneficial for these students.

Collectively, the site- and student-level heterogeneous effects support our hypothesis that the text message and peer mentor interventions should be most beneficial for students whom we reason lacked access to college planning supports and for students with less-developed college plans as of high school graduation. Both groups of students stood to benefit from the additional information and prompts contained in the text messages or from the additional outreach and encouragement from peer mentors. By contrast, the interventions may have been less impactful for students who had already received substantial college planning support, such as students in Boston or students in the top of the GPA distribution in their school district.

[22] Disaggregated results are similar in terms of both magnitude and statistical significance, but we exclude them here, given that they are derived from very small sample sizes.

4.3 Sensitivity tests

We conduct two sensitivity tests for the positive impacts we observe in Lawrence and Springfield.[23] First, we capitalize on records for whether uAspire had a student or parent phone number for each student to confirm whether the text message treatment impacts, in particular, were driven by the subset of students whom Signal Vine should have been able to message. We expect to find a larger impact for the subset of students with numbers than for the overall sample, since the overall sample impact will be attenuated by the inclusion of students in the treatment group who did not actually receive the intervention. Similarly, we should find no impact of the text intervention for students for whom uAspire did not have a student or parent number, since these students would not have received any text outreach. Because peer mentors could have used a variety of outreach strategies, we may still expect impacts of the peer mentor intervention regardless of cell phone number. Second, we investigate whether the overall enrollment impacts are consistent with the enrollment impacts we observe for the subset of students who intended to matriculate at an institution that participates in the National Student Clearinghouse. One potential concern with relying on the NSC for outcome data is that students may enroll in a higher education institution that does not participate in the NSC. If students in the treatment or control groups were differentially more likely to attend one of these institutions, our results could be biased. To the extent that students enroll at their intended institution,[24] examining the treatment impacts for the subset of students who planned to enroll at an NSC-matched institution may provide a benchmark for how much lack of full coverage in the NSC data could bias our program estimates.

In Lawrence and Springfield, we find a similar impact of the text intervention for the subset of students for whom uAspire had a number. We find no impact among students for whom uAspire did not have a number. For both the text and peer mentor interventions, the magnitude of the treatment impact for students intending to enroll at an NSC-matched institution was similar to the impact in the overall sample. These results are presented in Appendix Table A5.

[23] We are unable to conduct these analyses in Dallas because we lack the student-level cell phone and college intentions data required.

[24] This may be an overly strong assumption. For instance, in our 2011 summer college counseling intervention, only 73 percent of control group students enrolled at their intended college.

5. DISCUSSION

The summer 2012 text messaging and peer mentor outreach campaigns both had positive impacts on whether college-intending high school graduates from urban school districts enrolled in college, with effects concentrated among students with little access to college planning supports and students with less-developed college plans. We consider several hypotheses for how the text messaging and peer mentor interventions could impact students' outcomes. For the text messaging intervention, one possibility is that the text messages increased students' access to personalized college information and guidance about required college tasks they needed to complete, and/or simplified this information to make it easier to digest and respond. We find some evidence to support this hypothesis. Specifically, the text message impacts were largest in Lawrence and Springfield, where students had the least access to college planning supports. As a corollary, if the primary channel through which the texts operated was by increasing students' access to relevant college information, this could also explain the lack of impacts we observe in Boston. Because students already have access to so many college access organizations during the summer months, the marginal value of the information provided in the text messages may have been quite low.

We did observe a moderate number of click-throughs for the college- and task-specific web links included in each text message (Table A3). We cannot identify whether message recipients completed tasks when they clicked through these links, or just learned more about the required task, but this data does provide some evidence that the text intervention may have increased access to information about the tasks students needed to complete. Independent of the web links, the messages may have increased students' awareness or comprehension of required pre-matriculation tasks. In addition, they may have encouraged students to seek out more information through the relevant college websites, by revisiting information they had received directly from the college, or by contacting a staff member at the college. Finally, both interventions benefited students with undefined college plans and students who had not completed a FAFSA (with a uAspire advisor) by the start of the summer. These patterns are consistent with the hypothesis that students who are not as far along in their college planning (and therefore potentially facing unresolved financial aid issues or a lack of awareness of required summer tasks) could realize particular benefit from personalized information and assistance.

Another possibility is that text messages efficiently connected students to counselors who helped them address obstacles to enrollment. We do not find strong support for this hypothesis. In Dallas, less than six percent of students assigned to the text message intervention had substantive interaction with a counselor, so it is hard to imagine that individualized support from counselors drove the enrollment impacts we observed in Dallas. In Lawrence and Springfield, the rates of substantive interactions with a uAspire advisor were considerably higher, 29 percent and 20 percent of the text group, respectively. However, the rate of advisor interaction for students in the text group in Boston, 23 percent, was very similar, yet we observed no impact of the intervention in Boston. uAspire is very coherent and consistent in its advisor hiring guidelines and training protocols across sites, so the quality of and approach to advising should not differ greatly across sites. If anything, we would expect the Boston advisors to have a greater impact, given the higher volume of support resources and the presence of uAspire senior leadership within the Boston office. The positive impact of students working with a uAspire advisor in Boston was certainly evident in the summer 2011 college counseling intervention we described earlier. Therefore, we find little evidence to support the hypothesis that the text message impacts were driven by facilitating connections between students and counselors.

The hypothesis that is hardest to evaluate from the current information we have is whether the text messages operated by prompting students to address tasks when they received the message rather than procrastinating and putting them off until later in the summer. Preliminary evidence from a follow-up qualitative investigation suggests that the considerable majority of text message recipients found that the messages prompted them to complete a task to which they had not previously attended (Authors, in progress). We caution, however, that these conclusions are derived from a small sample of the text message recipients and not necessarily representative of the experimental sample overall. This hypothesis would be consistent with a growing body of research demonstrating that individual decision-making is quite responsive to planning prompts similar to the text messages we delivered (e.g. Karlan et al, 2010; Stockwell et al, 2012).

For the peer mentor intervention, one hypothesis articulated above is that students would be more responsive to outreach from peers, particularly if the peers used communication technologies prevalent among adolescents. At least compared to automated and personalized text messaging, we do find evidence that the peer mentor outreach resulted in substantially higher rates of interaction

with students. For instance, in Boston, compared to the 23 percent of students in the text group who interacted with an advisor, 55 percent of students in the peer mentor group interacted with a peer mentor or advisor.

Another possibility is that the peer mentors were able to positively influence students' perceptions of the social norms around postsecondary choices. Based on research noted above, we would expect peer mentors who shared similar characteristics to be most influential on students' perceptions. Nearly all of the peer mentors and students were racial/ethnic minorities.

Among the most striking features of the interventions, and particularly the text intervention, is their cost-effectiveness. There were two primary expenditures in the text campaign. The first was the cost of message delivery. Including the cost of up-front system design and the per-message delivery charges, the total messaging cost per student in the Dallas and uAspire treatment groups was approximately $2, or roughly $5,000 across both sites. The other primary expense was compensation for counselors to staff the summer intervention, which brought the per-student cost of the intervention to a mere $7 per student. The costs of the peer mentor intervention were primarily hourly wages to the peer mentors themselves and salary for supervising advisors. Together, the peer mentor intervention cost approximately $80 per student and so is less than but more similar in cost to the previous counselor-led interventions. Both interventions and the text messaging outreach in particular, therefore appear to be cost effective strategies to increase college enrollment among low-income students, especially when compared with other policy options to increase college access for underrepresented students. For instance, our prior summer counseling interventions cost $100 - $200 per student while generating enrollment increases of a similar magnitude. The financial aid literature has generally found that $1,000 in additional grant aid increases enrollment by 3 – 6 percentage points (Deming & Dynarski, 2009). Though neither of these examples provides an apples-to-apples comparison, as they involve different samples and/or stages of students' college trajectories, they nonetheless illustrate the potential cost-effectiveness and scalability of the text messaging campaign as a strategy to inform and support students through their college transition.

It is clearly an open and essential question whether the text and peer mentor interventions will have a long-term impact on students' outcomes. If the interventions are inducing students into college, only to have them drop out several months later, they could conceivably be doing harm, since students may have incurred debt to matriculate but have little to show for it in terms of

additional education. While it is encouraging that the summer 2011 college counseling intervention had pronounced impacts on sophomore year persistence (authors), it is possible that the text and peer mentor interventions impacted students' enrollment through different channels, and may therefore not have as persistent an impact on students' enrollment. We expect to track students' enrollment patterns over time.

The results we present here have significant implications for policy, practice, and research. Gaps in college enrollment and success by socioeconomic status have persisted for decades and have widened among recent cohorts (Bailey & Dynarski, 2012). School districts are under mounting pressure to increase college-going rates among underrepresented populations. Yet, districts often have limited resources with which to invest in initiatives to improve college access. Personalized text messaging and to a lesser degree peer mentor outreach combined with access to professional assistance may be affordable and effective strategies to increase college going among students from low- and moderate-income backgrounds. Both strategies indicate the potential for low-cost behavioral nudges and interventions to achieve meaningful improvements in students' educational outcomes.

More broadly, as educational agencies grapple with limited and, in some cases, declining budgets, practitioners and policymakers will need to develop low-cost, high-impact strategies to help low-income students and their families select and continue along educational pathways that prepare them for future success. The text messaging model, in particular, as a strategy to consolidate and personalize complex information and to facilitate connections between students, families, and school officials, could conceivably be applied to many stages in students' educational pathways: when they are choosing which primary or secondary schools to attend, which courses to take, and to which colleges to apply. Our results illustrate both the feasibility and impact of a text message campaign and serve to the set the stage for policymakers and practitioners to use similar strategies to support students in making better educational decisions and smoother transitions throughout their educational trajectories.

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Table 1: Summary statistics for baseline demographic characteristics, by site

	Dallas, TX		Boston, MA		Lawrence, MA		Springfield, MA		Philadelphia, PA	
	Full sample (1)	Analytic sample (2)	Full sample (3)	Analytic sample (4)	Full sample (5)	Analytic sample (6)	Full sample (7)	Analytic sample (8)	Full sample (9)	Analytic sample (10)
Female	0.51	0.56	0.59 [2,528]	0.60 [1,823]	0.61 [475]	0.63 [291]	0.58 [844]	0.59 [635]	0.54	0.56
Black	0.29 [7,952]	0.33 [2,865]	0.38 [2,152]	0.37 [1,631]	0.01 [335]	0.01 [236]	0.28 [768]	0.31 [574]	0.95	0.95
Hispanic	0.63 [7,952]	0.57 [2,865]	0.25 [2,152]	0.25 [1,631]	0.84 [335]	0.85 [236]	0.41 [768]	0.36 [574]	--	--
White	0.06 [7,952]	0.08 [2,865]	0.08 [2,152]	0.07 [1,631]	0.03 [335]	0.01 [236]	0.11 [768]	0.10 [574]	0.03	--
Other race/ethnicity	0.01 [7,952]	0.02 [2,865]	0.29 [2,152]	0.30 [1,631]	0.12 [335]	0.13 [236]	0.20 [768]	0.22 [574]	0.03	0.02
Qualified for free/reduced price lunch	0.78	0.79	0.78 [2,152]	0.78 [1,568]	0.89 [318]	0.88 [236]	0.78 [686]	0.76 [526]	0.65	0.65
Completed the FAFSA	0.36	1.00	0.74	0.88	0.64	0.85	0.71	0.84	--	0.95
N	8,066	2,920	2,574	1,843	487	294	981	696		443

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield).

Notes: Means are shown with standard deviations in parentheses (for continuous variables only) and the number of observations in brackets if less than full sample. The full sample includes all high school seniors in the agency (Dallas and Mastery) or all high school seniors with which the organization worked during the 2012-2013 academic year (uAspire). The analytic sample includes college-intending students, identified by completing the FAFSA (Dallas), meeting with an advisor at least twice during senior year of high school (uAspire), or reporting college intentions on a high school exit survey (Mastery). For uAspire sites, GPA is based on student self-report.

Table 2: Summary statistics for baseline academic achievement and college intention characteristics, by site

	Dallas, TX		Boston, MA		Lawrence, MA		Springfield, MA		Philadelphia, PA	
	Full sample (1)	Analytic sample (2)	Full sample (3)	Analytic sample (4)	Full sample (5)	Analytic sample (6)	Full sample (7)	Analytic sample (8)	Full sample (9)	Analytic sample (10)
Prior academic achievement										
Senior year GPA	3.29	3.38	--	--	--	--	--	--	2.56	2.86
	(0.21)	(0.18)							(1.04)	(0.65)
	[8,035]	[2,916]							[523]	[441]
State math assessment	0.00	0.29	--	--	--	--	--	--	0.00	0.05
	(1.00)	(0.89)							(1.00)	(0.985)
	[7,452]	[2844]							[310]	[285]
State ELA assessment	0.00	0.31	--	--	--	--	--	--	0.00	0.05
	(1.00)	(0.70)							(1.00)	(0.985)
	[7,452]	[2,844]							[310]	[285]
GPA < 2.0	--	--	0.13	0.11	0.16	0.13	0.17	0.15	--	--
			[1,868]	[1,448]	[304]	[226]	[563]	[425]		
GPA 2.0 – 3.0	--	--	0.42	0.41	0.37	0.34	0.44	0.42	--	--
			[1,868]	[1,448]	[304]	[226]	[563]	[425]		
GPA 3.0 – 4.0	--	--	0.46	0.48	0.47	0.53	0.40	0.43	--	--
			[1,868]	[1,448]	[304]	[226]	[563]	[425]		
Postsecondary intentions										
Intend on 2-year inst.	--	--	0.25	0.25	0.64	0.56	0.58	0.57		0.42
			[1,580]	[1,258]	[336]	[221]	[524]	[517]		[433]
Intend on 4-year public inst.	--	--	0.3	0.30	0.20	0.28	0.16	0.16		0.41
			[1,868]	[1,258]	[336]	[221]	[524]	[517]		[433]
Intend on 4-year private inst.	--	--	0.44	0.45	0.14	0.16	0.26	0.26		0.17
			[1,868]	[1,258]	[336]	[221]	[524]	[517]		[433]
N	8,066	2,920	2,574	1,843	487	294	981	696		443

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield).
Notes: Means are shown with standard deviations in parentheses (for continuous variables only) and the number of observations in brackets if less than full sample. See Table 1 for definitions of full and analytic samples.

Table 3. Assessment of baseline equivalence

	Dallas, TX		Boston, MA			Lawrence, MA			Springfield, MA			Philadelphia, PA	
	Text	Ctrl	Text	Peer	Ctrl	Text	Peer	Ctrl	Text	Peer	Ctrl	Peer	Ctrl
Female	0.56	0.56	0.60	0.60	0.59	0.68	0.60	0.61	0.62	0.63	0.63	0.55	0.57
Black	0.33	0.32	0.34	0.33	0.32	0.01	0.01	0.01	0.25	0.27	0.27	0.95	0.94
Hispanic	0.57	0.58	0.21	0.25	0.22	0.88	0.90	0.86	0.31	0.31	0.29	--	--
White	0.08	0.08	0.06	0.06	0.06	0.02	0.00	0.00	0.08	0.07	0.10	--	--
Other	0.02	0.01	0.26	0.25	0.29	0.09	0.09	0.13	0.19	0.16	0.19	0.01**	0.04
FRL	0.79	0.78	0.81	0.82	0.80	0.94	0.86	0.90	0.81	0.87*	0.81	0.63	0.68
FAFSA	--	--	0.88	0.87	0.88	0.86	0.88	0.82	0.82	0.87	0.84	0.95	0.96
GPA	3.38	3.38	--	--	--	--	--	--	--	--	--	2.87	2.85
GPA < 2.0	--	--	0.09*	0.10**	0.07	0.11	0.10	0.10	0.10	0.07	0.09	--	--
GPA 2.0 – 3.0	--	--	0.31	0.34	0.32	0.27	0.28	0.23	0.29	0.24	0.24	--	--
GPA 3.0 – 4.0	--	--	0.37	0.34**	0.41	0.62	0.63	0.67	0.25	0.23	0.29	--	--
State math assess.	0.28	0.30	--	--	--	--	--	--	--	--	--	0.03	-0.04
State ELA assess.	0.30	0.32	--	--	--	--	--	--	--	--	--	0.01	-0.05
Intend 2-year	--	--	0.19**	0.18*	0.14	0.63*	0.63*	0.75	0.69	0.69	0.68	0.41	0.42
Intend 4-year pub.	--	--	0.20*	0.18**	0.23	0.22	0.26*	0.15	0.11	0.12	0.13	0.39	0.40
Intend 4-year priv.	--	--	0.29	0.32	0.32	0.15	0.12	0.10	0.20	0.19	0.19	0.17	0.16
N uAspire mtgs.	--	--	3.98	4.21	4.11	4.29	4.36	3.84	4.58	4.41	4.64	--	--
χ^2 *omnibus test stat*	6.2		15.7	19.7		13.5	18.5		8.57	9.91		9.79	
(p-value)	(0.91)		(0.48)	(0.24)		(0.63)	(0.24)		(0.93)	(0.87)		(0.71)	

~ p <0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield).

Notes: Each cell presents covariate means controlling for fixed effects for level of randomization. FRL refers to whether the student qualified for free/reduced lunch. FAFSA refers to whether the student applied for federal financial aid. The "intend" variables indicate what type of institution in which the student intended to enroll as of graduation. "N uAspire mtgs" refers to the number of school-year advising meetings the student had. Indicators of statistical significance pertain to a comparison of covariate means between the relevant category and the control group. χ^2 statistic pertains to omnibus test of covariate balance developed by Hansen and Bowers (2008). Assessment of baseline equivalence was performed in Stata using xbalance. The omnibus test additionally accounts for baseline missingness.

Table 4: Text message delivery rates by intervention sites

	Dallas, TX	Boston, Springfield, and Lawrence MA
Total students assigned to receive text messages	1,454	1,070
Total student cell numbers sent to text messaging platform	843	806
Total *working* student cell numbers sent to text messaging platform	814	768
Proportion of students assigned to receive messages for whom there were working student cell numbers	0.56	0.72
Total parent cell numbers sent to text messaging platform	811	711
Total *working* parent #s sent to text messaging platform	663	232
Proportion of students assigned to receive messages for whom there were working parent cell numbers	0.46	0.22
Proportion of students for whom Signal Vine received a student *or* parent number	0.60	0.85

Source: Signal Vine administrative data

Notes: Signal Vine is the text messaging platform that delivered the text messages to students and parents. Signal Vine reported the number of student and parent cell numbers they received from each intervention site at the start of the intervention. Signal Vine also verified whether the numbers they received were working cell numbers, as opposed to land line numbers, no-longer-active cell numbers, or invalid phone numbers. Dallas ISD obtained student and parent numbers through a high school exit survey. uAspire obtained student and parent cell numbers for the Massachusetts intervention sites from a combination of exit surveys and advisors outreach to students. The Massachusetts delivery rates are grouped together because that is how they were recorded in the Signal Vine database.

Table 5: Response rates by experimental group and site

	Dallas, TX (1)	Boston, MA (2)	Lawrence, MA (3)	Springfield, MA (4)	Philadelphia, PA (5)
Text message response rates among students assigned to receive text message outreach					
Replied to at least one text message	0.313*** (0.012)	0.367*** (0.018)	0.480*** (0.050)	0.341*** (0.029)	--
Replied to at least one text message to request an advising meeting	0.118*** (0.008)	0.192*** (0.015)	0.310*** (0.046)	0.161*** (0.022)	--
N	2,920	1,843	294	696	--
Fixed effects for level of randomization	✓	N/A	N/A	N/A	--
Rate of counselor / advisor interaction					
Text message	0.058*** (0.006)	0.123*** (0.016)	0.180** (0.055)	0.114*** (0.024)	--
Peer mentor	--	0.437*** (0.025)	0.443*** (0.060)	0.387*** (0.042)	0.526*** (0.033)
Control group meeting rate	0 (0.001)	0.043*** (0.008)	0.110*** (0.031)	0.033** (0.011)	0.044** (0.016)
N	2,920	1,843	294	696	443
Fixed effects for level of randomization	✓	N/A	N/A	N/A	✓

~ p <0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield sites). Notes: Robust standard errors are reported in parentheses. The coefficients reported are from linear probability models. Sample sizes reported here pertain to the full sample. Top panel: text message response rates, by construction, were 0 among students in the text message control group. Bottom panel: The take-up rates for the text message and peer mentor groups are respectively the sum of the coefficients on text message and control and the sum of the coefficients on peer mentor and control.

Table 6: Impact of the text message interventions on Fall 2012 enrollment, by intervention site

	Dallas, TX			Boston, MA			Lawrence & Springfield, MA			Pooled sample		
	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Text message	0.024	-0.031	**0.049****	-0.016	-0.019	-0.006	**0.071***	0.042	0.035	0.019	-0.018	**0.030***
	(0.017)	(0.020)	**(0.017)**	(0.026)	(0.032)	(0.016)	**(0.035)**	(0.034)	(0.036)	(0.013)	(0.016)	**(0.012)**
Control group enrollment	0.718	0.385	0.432	0.701	0.520	0.095	0.628	0.146	0.273	0.696	0.386	0.202
N	2,920	2,920	2,920	1,843	1,843	1,843	990	990	990	5753	5753	5753
Pseudo-R^2	0.10	0.22	0.08	0.16	0.34	0.19	0.13	0.50	0.18	0.116	0.307	0.146
Full set of controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed effects for level of randomization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

~ p <0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield sites).

Notes: Robust standard errors are reported in parentheses. Coefficients presented are marginal effects from probit regressions with the covariates set at their means. Controls include gender, race/ethnicity, whether students qualified for free/reduced price lunch, high school GPA (senior year GPA from administrative records in Dallas, self-reported cumulative GPA in uAspire sites), math and ELA state assessment scores (Dallas), whether the student completed the Free Application for Federal Student Aid (uAspire), the number of meetings students had with a uAspire advisor during senior year (uAspire only), the type of institution to which students intended to enroll (uAspire), and whether the student was assigned to a peer mentor intervention implemented concurrently in the uAspire sites (uAspire only). Models include indicator variables for missingness for any covariate with missing values (including missingness because the measure is only recorded for one of the intervention sites).

Table 7: Impact of the peer mentor interventions on Fall 2012 enrollment, by intervention site

	Boston, MA			Lawrence & Springfield, MA			Philadelphia, PA			Pooled sample		
	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year	Overall enroll	Enroll at 4-year	Enroll at 2-year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Peer mentor	0.035	0.043	-0.003	0.036	0.049	0.008	-0.023	0.019	-0.020	0.023	**0.045~**	-0.004
	(0.029)	(0.036)	(0.017)	(0.040)	(0.044)	(0.041)	(0.050)	(0.061)	(0.028)	(0.021)	(0.027)	(0.016)
Control group enrollment	0.701	0.520	0.095	0.628	0.146	0.273	0.675	0.421	0.107	0.676	0.388	0.142
N	1,843	1,843	1,843	990	990	990	443	443	443	3276	3276	3276
Pseudo-R^2	0.16	0.34	0.19	0.13	0.50	0.18	0.222	0.439	0.24	0.15	0.406	0.223
Full set of controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed effects for level of randomization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

~ p <0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield sites).

Notes: Robust standard errors are reported in parentheses. Coefficients presented are marginal effects from probit regressions with the covariates set at their means. Controls include gender, race/ethnicity, whether students qualified for free/reduced price lunch, high school GPA (senior year GPA from administrative records in Mastery, self-reported cumulative GPA in uAspire sites), math and ELA state assessment scores (Mastery), whether the student completed the Free Application for Federal Student Aid (uAspire and Mastery), the number of meetings students had with a uAspire advisor during senior year (uAspire only), the type of institution to which students intended to enroll (uAspire and Mastery), and whether the student was assigned to a peer mentor intervention implemented concurrently in the uAspire sites (uAspire only). Models include indicator variables for missingness for any covariate with missing values (including missingness because the measure is only recorded for one of the intervention sites).

Table 8. Heterogeneous effects of the text message and peer mentor interventions on Fall 2012 enrollment by selected student characteristics, by intervention site

	Dallas, TX	Boston, MA		Lawrence / Springfield, MA		Phila., PA	Pooled sample	
	Text	Text	Peer mentor	Text	Peer mentor	Peer Mentor	Text	Peer mentor
Low GPA	-0.038 (0.126)	-0.08 (0.089)	-0.047 (0.094)	-0.035 (0.111)	0.038 (0.119)	-0.066 (0.065)	-0.058 (0.061)	-0.037 (0.048)
Moderate GPA	**0.041*** **(0.019)**	0.031 (0.040)	**0.083~** **(0.040)**	0.032 (0.065)	-0.051 (0.080)	0.116 (0.087)	**0.040*** **(0.016)**	**0.058~** **(0.034)**
High GPA	-0.032 (0.040)	-0.069 (0.047)	-0.034 (0.052)	-0.001 (0.068)	0.006 (0.079)	-0.127 (0.163)	-0.04 (0.028)	-0.032 (0.042)
College plans not specified	--	0.033 (0.040)	**0.086~** **(0.041)**	**0.109~** **(0.058)**	0.095 (0.069)	--	**0.059~** **(0.033)**	**0.088*** **(0.035)**
Specified college plans	--	-0.047 (0.035)	-0.001 (0.038)	0.053 (0.042)	0.014 (0.048)	--	-0.013 (0.027)	-0.004 (0.026)
FAFSA not completed	--	--	--	--	--	--	**0.200**** **(0.061)**	0.077 (.072)
FAFSA completed	--	--	--	--	--	--	-0.009 (0.022)	-.030 (0.025)

~ p <0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Dallas ISD, Mastery and uAspire administrative records (for Boston, Lawrence, and Springfield sites).

Notes: Robust standard errors are reported in parentheses. Coefficients presented are marginal effects from probit regressions with the covariates set at their means. Controls include gender, race/ethnicity, whether students qualified for free/reduced price lunch, high school GPA (senior year GPA from administrative records in Dallas and Mastery, self-reported cumulative GPA in uAspire sites), math and ELA state assessment scores (Dallas and Mastery), whether the student completed the Free Application for Federal Student Aid (uAspire and Mastery), the number of meetings students had with a uAspire advisor during senior year (uAspire only), the type of institution to which students intended to enroll (uAspire and Mastery), and whether the student was assigned to a peer mentor intervention implemented concurrently in the uAspire sites (uAspire only). Models include indicator variables for missingness for any covariate with missing values (including missingness because the measure is only recorded for one of the intervention sites).